UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
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BIN C15700
Seattle, WA 98115-0070

June 12, 2003

Thomas F. Mueller
Chief Regulatory Branch
Department of the Army
Seattle District Corps of Engineers
Post Office Box 3755
Seattle, Washington 98124-3755

Re: Biological Opinion and Essential Fish Habitat Consultation for the construction of the Ice Harbor Marina at Charbonneau Park, Walla Walla County, Washington. (NMFS Tracking No.: 2001/01278) (WRIA 33)

Dear Mr. Mueller:

In accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended, 16 USC 1536, and the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, 16 USC 1855, the attached document transmits the NOAA's National Marine Fisheries Service (NOAA Fisheries) Biological Opinion (Opinion) and MSA consultation on the proposed Ice Harbor Marina project in Walla Walla County, Washington.

The U.S. Army Corps of Engineers (COE) has determined that the proposed action was likely to adversely affect Snake River (SR) fall chinook (*O. tshawytscha*) , SR spring/summer-run chinook (*O. tshawytscha*), SR Basin steelhead (*O. mykiss*), and SR sockeye salmon (*O. nerka*) Evolutionary Significant Units. Formal consultation was initiated on May 5, 2003.

This Opinion reflects formal consultation and an analysis of effects covering the above listed species in the Snake River above Ice Harbor Dam and below Lower Monumental Dam, Washington. The Opinion is based on information provided in the biological assessment received by NOAA Fisheries on December 13, 2001, the addendums received January 27, 2002, May 30, 2002, March 6, 2003, and May 5, 2003, subsequent information transmitted by telephone conversations, fax, mail, and electronic mail. A complete administrative record of this consultation is on file at the Washington State Habitat Branch Office.

NOAA Fisheries concludes that the implementation of the proposed project is not likely to jeopardize the continued existence of the above listed species or result in the destruction or adverse modification of their critical habitat. Please note that the incidental take statement, which includes reasonable and prudent measures and terms and conditions, was designed to minimize take.

The MSA consultation concluded that the proposed project may adversely impact designated Essential Fish Habitat (EFH) for chinook and coho (*O. kisutch*) salmon. Specific reasonable and Prudent Measures of the ESA consultation, and Terms and Conditions identified therein, would address the negative effects resulting from the proposed COE actions. Therefore, NOAA Fisheries recommends that they be implemented as EFH conservation measures.

If you have any questions, please contact Justin Yeager of the Washington State Habitat Branch Office at (509) 925-2618 or email at justin.yeager@noaa.gov.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

Enclosure

Endangered Species Act - Section 7 Consultation

Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act

Essential Fish Habitat Consultation

Twenty-Three Finger Piers at Ice Harbor Marina
Walla Walla County, Washington

NMFS Tracking No.: 2001/01278

Agency:	U.S. Army Corps of Engineers
Consultation Conducted By:	National Marine Fisheries Service Northwest Region, Washington Habitat Branch

Issued by: For Michael R Crouse   Date Issued: June 12, 2003

D. Robert Lohn
Regional Administrator

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1.0 INTRODUCTION

This document reflects the results of an Endangered Species Act (ESA) section 7 formal consultation and Magnuson-Stevens Fishery Conservation and Management Act (MSA) Essential Fish Habitat (EFH) consultation between NOAA's National Marine Fisheries Service (NOAA Fisheries) and the U.S. Army Corps of Engineers (COE) for the proposed Ice Harbor Marina Project, Walla Walla County, Washington (COE No. 2001-1-01278). The proposed action will occur within the geographic boundaries and habitats of several Evolutionarily Significant Units (ESU[1]) and the ESA listed salmon and steelhead therein, including endangered Snake River (SR) sockeye (*Oncorhynchus nerka*), threatened SR fall (SRF) chinook (*O. tshawytscha*), threatened Snake River spring/summer (SRSS) chinook (*O. tshawytscha*), and threatened Snake River Basin (SRB) steelhead (*O. mykiss*). Additionally, the proposed action area is designated as Essential Fish Habitat (EFH) for chinook (*O. tshawytscha*) and coho (*O. kisutch*) salmon.

The purpose of this document is to present NOAA Fisheries' opinion on whether the proposed action is likely to jeopardize the continued existence of the SR sockeye, SRF chinook, SRSS chinook, and SRB steelhead ESUs listed under the ESA, or result in the destruction or adverse modification of their designated Critical Habitat (excluding SR steelhead; see footnote 2) Further, this document presents NOAA Fisheries' determination on whether the proposed action will adversely affect designated coho and chinook salmon EFH. NOAA Fisheries makes these ESA and EFH determinations by analyzing the biological effects of construction activities related to the Ice Harbor Marina Project, relating those effects to the biological and ecological needs of listed species, and then adding these effects to the environmental baseline of the action area.

1.1 Background and Consultation History

The COE is proposing to permit the construction of 23 docks in the Snake River at Ice Harbor Marina to increase moorage. The docks will be constructed at Charbonneau Park, located on the south bank of the Snake River at river mile 11.5.

On December 13, 2001, NOAA Fisheries received a request from the COE for ESA section 7 formal consultation (dated December 10, 2001) to permit the construction of 23 docks at Charbonneau Park. This document has been prepared in response to the initiation letter, the accompanying undated Biological Assessment (BA) and addenda, and the following written correspondence: (1) a January 25, 2002, letter from the applicant to NOAA Fisheries with attached mitigation plan; (2) a May 29, 2002 letter and sounding chart of the marina from the COE that was requested on a March 12, 2002 site visit attended by NOAA Fisheries, COE, State

[1] "ESU" means a population or group of populations that is considered distinct (and hence a "species") for purposes of conservation under the ESA. To qualify as an ESU, a population must (1) be reproductively isolated from other conspecific populations, and (2) represent an important component in the evolutionary legacy of the biological species (Waples 1991a).

agencies, and the applicant; (3) and additional information received on March 6, 2003 and May 5, 2003.

Additionally, numerous telephone conversations and a March 12, 2002 and January 14, 2003 site visit attended by NOAA Fisheries, COE, State agencies, and the applicant are included in the administrative record. Formal consultation began on May 5, 2003.

1.2 Description of the Proposed Action

Dock Construction

The proposed Ice Harbor Marina consists of 23 new docks that each have three components; a shore anchor, ramp, and float. The shore anchors are 5 feet by 10 feet and are composed of concrete. They are located above a crib wall on a gravel walk way. The ramps connect the shore anchor with the float and are 3.75 feet by 11.6 feet and fully grated. The float is 4 feet by 17 feet and fully grated. Each float will have two, white, fully encapsulated floatation tubs to maintain buoyancy. The Aluminum grating on the ramps and floats will have an ambient light passage of 69%. All dock construction will occur between June 15 and August 31, 2003.

Riparian Planting

As part of the new Ice Harbor Marina project, the applicant will plant a 950-foot long area. The plantings will consist of 20 cottonwood trees (*Populus trichocarpa*), spaced 50 feet apart on center along the shoreline. The applicant will monitor the plantings for 5 years and replace any dead trees.

1.3 Description of the Action Area

Under the ESA, the "action area" is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for this project is the Snake River from Ice Harbor Dam at river mile 9.7 to Lower Monumental Dam at river mile 41.6. Although most effects of the action will be localized, increases in predator populations and boating traffic have the potential to affect listed salmonids throughout the reservoir.

2.0 ENDANGERED SPECIES ACT

2.1 Biological Opinion

The objective of this Biological Opinion (Opinion) is to determine whether the proposed project is likely to jeopardize the continued existence of the SR sockeye, SRF chinook, SRSS chinook, and SRB steelhead ESUs, or result in the destruction or adverse modification of their designated Critical Habitat (excluding SRB steelhead).

2.1.1 Status of Species

The listing status, biological information, and Critical Habitat elements or potential Critical Habitat for NOAA Fisheries listed species that are the subject of this consultation are described below in Table 1.

Species	Listing Status	Critical Habitat	Protective Regulations	Biological Information
Snake River sockeye salmon	November 20, 1991; 56 FR 58619, Endangered	December 28, 1993; 58 FR 68543	November 20, 1991; 56 FR 58619	Waples *et al.* 1991a
Snake River fall chinook salmon	April 22, 1992; 57 FR 14653, Threatened	December 28, 1993; 58 FR 68543	April 22, 1992; 57 FR 14653	Waples *et al.* 1991b
Snake River spring/summer-run chinook salmon	April 22, 1992; 57 FR 14653, Threatened	December 28, 1993; 58 FR 68543	April 22, 1992; 57 FR 14653	Matthews and Waples 1991
Snake River Basin steelhead	August 18, 1997; 62 FR 43937, Threatened	Not Designated[2]	July 10, 2000; 65 FR 42422	Busby *et al.*1995; 1996

Table 1. References for Additional Background on Listing Status, Biological Information, and Critical Habitat Elements for the Listed Species Addressed in this Opinion.

The proposed action will occur within the designated Critical Habitat of endangered SR sockeye, threatened SRF chinook, and threatened SRSS chinook salmon. Essential features of this Critical Habitat include substrate (especially spawning gravels), water quality/quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (December 28, 1993, 58 FR 68543,).

Throughout the Columbia Basin, salmonids have been negatively affected by a combination of habitat alteration and hatchery management practices. Mainstem dams on the Snake River, are perhaps the most significant source of habitat degradation for the ESUs addressed under this consultation. The dams act as a partial barrier to passage, kill out-migrating smolts in their turbines, raise temperatures throughout the river system, and have created lentic refugia for salmonid predators. In addition to dams, irrigation systems have had a major negative impact by diverting large quantities of water, stranding fish, acting as barriers to passage, and returning effluents containing chemicals and fine sediments. Other major habitat degradation has occurred

[2]Under development. On April 30, 2002, the U.S. District Court for the District of Columbia approved a NOAA Fisheries consent decree withdrawing a February 2000 Critical Habitat designation for this and 18 other ESUs.

through urbanization and livestock grazing practices (WDFW *et al.* 1993; Busby *et al.* 1996; NMFS 1996a; 1998; 2000; April 22, 1992, 64 FR 14308; August 18, 1997, 62 FR 43937).

Habitat alterations and differential habitat availability (*e.g.*, fluctuating discharge levels) impose an upper limit on the production of naturally spawning populations of salmon and steelhead. The National Research Council Committee on Protection and Management of Pacific Northwest Anadromous Salmonids identified habitat problems as a primary cause of declines in wild salmon runs (NRCC 1996). Some of the habitat impacts identified were the fragmentation and loss of available spawning and rearing habitat, migration delays, degradation of water quality, removal of riparian vegetation, decline of habitat complexity, alteration of stream flows and streambank and channel morphology, alteration of ambient stream water temperatures, sedimentation, and loss of spawning gravel, pool habitat, and (LWD) (NMFS 1996a; 1998; NRCC 1996; Bishop and Morgan 1996).

Hatchery management practices are suspected to be a major factor in the decline of these ESUs. The genetic contribution of non-indigenous, hatchery stocks may have reduced the fitness of the locally adapted native fish through hybridization and associated reductions in genetic variation or introduction of deleterious (non-adapted) genes. Hatchery fish can also directly displace natural spawning populations, compete for food resources, or engage in agonistic interactions (Campton and Johnston 1985; Waples *et al.* 1991a; Hilborn 1992; NMFS 1996a; March 10, 1998, 63 FR 11798).

The following information summarizes the status of Snake River salmonids by ESU that are the subjects of this consultation. Most of this narrative was largely taken from the Biological Opinion on Reinitiation of Consultation on Operation of the Federal Columbia River Power System (FCRPS), including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin (NMFS 2000).

2.1.1.1 Snake River Sockeye

The SR sockeye salmon ESU, listed as endangered on November 20, 1991 (56 FR 58619), includes populations of sockeye salmon from the Snake River Basin, Idaho (extant populations occur only in the Salmon River subbasin). Under NOAA Fisheries' interim policy on artificial propagation (April 5, 1993, 58 FR 17573), the progeny of fish from a listed population that are propagated artificially are considered part of the listed species and are protected under the ESA. Thus, although not specifically designated in the 1991 listing, SR sockeye salmon produced in the captive broodstock program are included in the listed ESU. Given the dire status of the wild population under any criteria (16 wild and 264 hatchery-produced adult sockeye returned to the Stanley Basin between 1990 and 2000), NOAA Fisheries considers the captive broodstock and its progeny essential for recovery. Critical Habitat was designated for SR sockeye salmon on December 28, 1993 (58 FR 68543).

Snake River sockeye were historically abundant in several lake systems of Idaho and Oregon. However, all populations have been extirpated in the past century; the only remaining sockeye in the Snake River system are found in Redfish Lake, in the Stanley Basin on the Salmon River. The nonanadromous form (kokanee), found in Redfish Lake and elsewhere in the Snake River Basin, is included in the ESU. SR sockeye occur within the action area only during their smolt and adult migrations.

2.1.1.2 Snake River Fall Chinook

The SRF chinook salmon ESU, listed as threatened on April 22, 1992 (57 FR 14653), includes all natural-origin populations of fall chinook in the mainstem Snake River and its tributaries. Fall chinook from the Lyons Ferry Hatchery are included in the ESU but are not listed. Critical Habitat was designated for SRF chinook salmon on December 28, 1993 (58 FR 68543).

The Snake River Basin drains an area of approximately 280,000 square kilometers and incorporates a range of vegetative life zones, climatic regions, and geological formations, including the deepest canyon (Hells Canyon) in North America. The location, geology, and climate of the Snake River region create a unique aquatic ecosystem for chinook salmon. The ESU includes the mainstem river and all tributaries (*e.g.*, Tucannon, Grande Ronde, Clearwater, and Salmon Rivers), from their confluence with the Columbia River to the Hells Canyon complex. Because genetic analyses indicate that fall-run chinook salmon in the Snake River are distinct from the spring/summer-run in the Snake Basin (Waples *et al.* 1991b), SRF chinook salmon are considered separately from the other two forms. They are also considered separately from those assigned to the Upper Columbia River summer- and fall-run ESU because of considerable differences in habitat characteristics and adult ocean distribution, and less definitive, but still significant, genetic differences.

The SRF chinook salmon remained stable at high levels of abundance through the first part of the twentieth century, but then declined substantially. Although the historical abundance of fall chinook salmon in the Snake River is difficult to estimate, adult returns appear to have declined by three orders of magnitude since the 1940s, and perhaps by another order of magnitude from pristine levels. Irving and Bjornn (1981) estimated that the mean number of fall chinook salmon returning to the Snake River declined from 72,000 during the period 1938 to 1949 to 29,000 during the 1950s. Further declines occurred upon completion of the Hells Canyon complex, which blocked access to primary salmonid production areas in the late 1950s (see section 2.1.2.2.2).

It is possible that a few SRF chinook may utilize the action area as spawning habitat, but the majority of adults moving through the reach are destined for upriver spawning sites. Therefore, SRF chinook are most reliant on the action area for rearing and migration. Anecdotal evidence suggests that some SRF chinook exhibit a stream type life history and might be in the action area during construction activities.

2.1.1.3 Snake River Spring/Summer Chinook

The SRSS chinook salmon ESU, listed as threatened on April 22, 1992 (57 FR 14653), includes all natural-origin populations in the Tucannon, Grande Ronde, Imnaha, and Salmon rivers. Some or all of the fish returning to several of the hatchery programs are also listed including those returning to the Tucannon River, Imnaha, and Grande Ronde hatcheries, and to the Sawtooth, Pahsimeroi, and McCall hatcheries on the Salmon River. Critical Habitat was designated for SRSS chinook salmon on December 28, 1993 (58 FR 68543), and was revised on October 25, 1999 (64 FR 57399).

Spring- and/or summer-run chinook salmon are found in several subbasins of the Snake River (CBFWA 1990). Of these, the Grande Ronde and Salmon rivers are large, complex systems composed of several smaller tributaries that are further composed of many small streams. In contrast, the Tucannon and Imnaha rivers are small systems with most salmon production in the main river. In addition to these major subbasins, three small streams (Asotin, Granite, and Sheep creeks) that enter the Snake River between Lower Granite and Hells Canyon Dam provide small spawning and rearing areas (CBFWA 1990). Although there are some indications that multiple ESUs may exist within the Snake River Basin, the available data do not clearly demonstrate their existence or define their boundaries. Because of compelling genetic and life-history evidence that fall chinook salmon are distinct from other chinook salmon in the Snake River, however, they are considered a separate ESU.

Historically, spring and/or summer chinook salmon spawned in virtually all accessible and suitable habitat in the Snake River system (Evermann 1895; Fulton 1968). During the late 1800s, the Snake River produced a substantial fraction of all Columbia River Basin spring and summer chinook salmon, with total production probably exceeding 1.5 million in some years. By the mid-1900s, the abundance of adult spring and summer chinook salmon had greatly declined. Fulton (1968) estimated that an average of 125,000 adults per year entered the Snake River tributaries from 1950 through 1960. As evidenced by adult counts at dams, however, spring and summer chinook salmon have declined considerably since the 1960s (COE 1989).

SRSS chinook are not thought to rear in the impounded portions of the Snake River. They do, however, pass through the action area on their adult and smolt migrations.

2.1.1.4 Snake River Basin Steelhead

The SRB steelhead ESU, listed as threatened on August 18, 1997 (62 FR 43937), includes all natural-origin populations of steelhead in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho. None of the hatchery stocks in the Snake River Basin are listed, but several are included in the ESU. Critical Habitat is not presently designated for SR steelhead, although a re-designation is likely forthcoming (see footnote 2).

Steelhead spawning habitat in the Snake River Basin is distinctive in having large areas of open, low-relief streams at high elevations. In many Snake River tributaries, spawning occurs at a higher elevation (up to 2,000 meters) than for steelhead in any other geographic region. Also, SRB steelhead also migrate farther from the ocean (up to 1,500 kilometers) than most.

The SRB steelhead are not known to spawn or rear in the impounded reaches of the Snake River. However, adult SRB steelhead are known to hold in the mainstem Snake River for extended periods (months) prior to spawning, and thus are likely to be in the action area during the proposed work window.

2.1.2 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR part 402 (the consultation regulations). NOAA Fisheries must determine whether the action is likely to jeopardize the listed species. This analysis involves the initial steps of (1) defining the biological requirements of the listed species and (2) evaluating the relevance of the environmental baseline to the species' current status.

From that, NOAA Fisheries evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NOAA Fisheries considers estimated levels of mortality attributed to: (1) collective effects of the proposed or continuing action; (2) the environmental baseline; and (3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed salmonid's life stages that occur beyond the action area. If NOAA Fisheries finds that the action is likely to jeopardize, NOAA Fisheries must identify reasonable and prudent alternatives for the action.

Furthermore, NOAA Fisheries evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' designated Critical Habitat. NOAA Fisheries must determine whether habitat modifications appreciably diminish the value of Critical Habitat for both survival and recovery of the listed species. NOAA Fisheries identifies those effects of the action that impair the function of any essential element of Critical Habitat. NOAA Fisheries then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NOAA Fisheries concludes that the action will adversely modify Critical Habitat it must identify any reasonable and prudent alternatives available.

2.1.2.1 Biological Requirements

The first step in the methods NOAA Fisheries uses for applying ESA section 7(a)(2) to listed salmon is to define the species' biological requirements that are most relevant to each consultation. NOAA Fisheries also considers the current status of the listed species; taking into account population size, trends, distribution, and genetic diversity. To assess the current status of the listed species, NOAA Fisheries starts with the determinations made in its original decision to list the species for protection under the ESA. In addition, the assessment will consider any new information or data that are relevant to the determination.

The relevant biological requirements are those necessary for the listed species to survive and recover to naturally reproducing population levels at which time protection under the ESA would be unnecessary. Species or ESUs not requiring ESA protection have the following attributes: population sizes large enough to maintain genetic diversity and heterogeneity, the ability to adapt to and survive environmental variation, and are self-sustaining in the natural environment.

The SR sockeye, SRF chinook, SRSS chinook, and SRB steelhead share similar basic biological requirements. These requirements include food, flowing water (quantity), high quality water (cool, free of pollutants, high dissolved oxygen concentrations, low sediment content), clean spawning substrate, and unimpeded migratory access to and from spawning and rearing areas (adapted from Spence *et al.* 1996). Even slight modifications of these habitat elements can produce deleterious effects to these listed salmonids and their Critical Habitat (in the case of SR sockeye, SRF chinook, and SRSS chinook). The biological requirements most likely to be affected by the proposed action include water quality, migratory freedom, and food production.

2.1.2.2 Environmental Baseline

The environmental baseline represents the current basal set of conditions to which the effects of the proposed action would be added. The term "environmental baseline" means "the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process " (50 CFR 402.02).

The headwaters of the Snake River emerge from the Grand Teton Mountains in western Wyoming and flow for 1,040 miles where they converge with the Columbia River in southeastern Washington State. Anadromous fish are only able to ascend the mainstem Snake River up to Hells Canyon Dam, located along the Oregon/Idaho border. Below its confluence with the Clearwater River near the mouth of Hells Canyon, the Lower Snake River consists of a series of four reservoirs, each approximately 36 miles in length, that extend from Lewiston, Idaho at Snake River mile 139 to Pasco, Washington at the confluence of the Snake and Columbia Rivers. These facilities (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams), were constructed by the COE between 1955 and 1975 to provide slackwater shipping, produce hydroelectric power, and supply water for irrigated agriculture.

The Snake River Basin traverses a number of physiographic provinces and ecoregions along its seaward migration, and thus climate, topography, precipitation, and vegetative cover are highly variable (Omernik 1987). This variable physical setting produces a range of aquatic and terrestrial habitats ranging from high mountain meadows with perennial streams to lowland desert scrublands with ephemeral torrents. With respect to anadromous fishery resources, the Snake River Basin once supported abundant and diverse runs of salmon and steelhead that now return in just a fraction of their historic numbers (Nehlsen *et al.* 1991; Busby *et al.* 1996; NMFS 1996a; 1998; 2000).

Within the action area, the Snake River resides in a canyon of Miocene-aged Columbia River Flood basalts. The area receives around 17 inches of precipitation per year, and supports few perennial streams. Upland vegetation ranges from scrub-shrub species to sparse conifer stands, and in areas where loess soils are thick enough and water available, row crops such as potatoes and wheat dominate (Williamson *et al.* 1998). The action area contains backflood deposits from the Missoula Floods (Bretz 1969), and also conveyed the Bonneville Flood (Malde 1968; O'Connor 1993) westward to the prehistoric Pacific Ocean. Consequently, flood deposits, old river terraces, and other depositional areas above adjacent reservoir pool levels are used for borrow and gravel pits. Other major land uses in the action area include rangeland grazing and recreation.

Water quality in the action area is generally poor. Hydroelectric facilities, agricultural runoff, and lack of riparian vegetation contribute to high temperatures, dissolved nutrients and pesticides, altered streamflow regimes, and fine sediment influx. The toxicity of these water quality constituents can be made more chronic by large impoundments with relatively minor volumetric turnover and high temperatures throughout the summer as natural inflow decreases.

Endangered SR sockeye and threatened SRF chinook, SRSS chinook, and SRB steelhead are currently affected by a number of habitat modifications within the action area. The most prominent and deleterious modifications are the result of hydroelectric facilities and the general transformation of the landscape, both aquatic and terrestrial, that these dams have produced. Specifically, hydropower dams have inundated riverine and floodplain habitats, transformed a riverscape into a series of slackwater reservoirs, altered water chemistry and sediment transport dynamics, truncated natural runoff patterns, restricted habitat access, and altered aquatic species assemblages.

The impoundment of the Snake River in the action area has removed riverscape attributes vital to the survival and recovery of listed salmonids. Riverine structure and function are determined by the changing temporal interaction of the physical, chemical, and biological components of a river, along three physical dimensions: longitudinal (headwaters to downstream), vertical (water circulation into bed sediments of the channel and floodplain), and horizontal (water circulation onto and from floodplains) (Hynes 1983; Ward and Stanford 1995b). Floodplains, their riparian wetlands, and interconnected mosaics of aquatic and semi-aquatic habitats are integral components of rivers (Stanford and Gonser 1998), and the species that depend upon them for survival (Minshall *et al.* 1985; Stanford *et al.* 1996). Disconnecting river channels from their floodplain habitats by flow regulation, impoundment, and/or revetment can compromise the ecological integrity of riverine ecosystems (Sedell *et al.* 1990; Stanford and Hauer 1992; Ward and Stanford 1995a). Altering the runoff regime or channel hydraulics under which streams developed can produce channel forms that are dissimilar to the natural condition (Leopold *et al.* 1964), which can have corresponding detrimental effects to the organisms that coevolved within the same river system (Vannote *et al.* 1980; Wallace *et al.* 1982; Minshall *et al.* 1983). The impact of hydropower development within the action area has virtually erased the physical habitat template of a riverine ecosystem, and the native aquatic community has suffered accordingly.

Sedimentation, turbidity, and nutrient enrichment can directly affect salmonids, and alter the structure and function of the environment in which they live. Concurrent with physical changes, indirect biological transformation has also occurred within the action area. Oftentimes, nonnative species are better suited to thrive in impacted systems (Stanford 1994), and altered physical habitats can help expand the niche of native predators resulting in increased populations and predation success. Non-native species that prey on salmonids, including percids and centrarchids, have become established in the Snake River (Wydoski and Whitney 1979). These predators may feed directly on salmonids (Tabor *et al.* 1993) or compete for other food or habitat resources. McMichael *et al.* (1998) postulated that increased water temperature, turbid summer water conditions, and elevated digestive capabilities afforded by degraded water quality in the lower Yakima River, Washington resulted in increased predation rates by piscine predators (both native and non-native) on outmigrating salmon and steelhead. Other native predators, including pikeminnow (*Ptychocheilus oregonensis),* have exploited the impounded environment created by dams, although their predation rates are higher in the lower Columbia River (Faler *et al.* 1988).

A number of general anthropogenic development factors have also influenced listed species. Along the shores of the Snake River throughout the action area, agriculture, transportation infrastructure, and commercial development have displaced riparian and shallow water habitat used by juvenile salmonids. This development also contributes some quantity of runoff and pollution, which may include sediments, fertilizer, pesticides, and petroleum products. Additionally, these activities have degraded riparian habitat by direct canopy removal, covering the ground with materials that preclude plant growth, reducing the widths of riparian zones, and altering riparian species composition in favor of non-native plants. Degraded riparian zones contribute an inadequate amount of LWD, and marina and private dock developments have fostered habitats where piscine predators are more successful.

At the project site, Charbonneau Park encompasses 244 acres with the marina in the middle of the Park. Upstream on the east side of the marina lies a 54 site campground. Downstream on the west side of the marina lies a day use area with a swim beach, shelters, and a playground.

The marina was dredged in 1981 and has an eight and one-half-foot crib wall that borders the west and south ends of the marina. The crib wall was built in conjunction with Ice Harbor Dam. A 12-foot wide gravel walkway exists around the periphery of the crib wall. East of the marina is a small section of riparian vegetation, consisting of willows and grass. Overall the Park has little vegetation and natural riparian character. Other lands near the Park consist of shrub steppe vegetation.

The landscape in the action area has been heavily altered. A once riverine environment has been converted to a lake/reservoir system. This system favors salmonid predators and paves the way for increased recreation and agricultural development, which can further degrade salmonid habitat.

2.1.2.2.1 Factors Affecting the Species at the Population Scale

Snake River Sockeye

Life History. In general, juvenile sockeye salmon rear in the lake environment for 1, 2, or 3 years before migrating to sea. Adults typically return to the natal lake system to spawn after spending 1, 2, 3, or 4 years in the ocean (Gustafson *et al.* 1997).

Habitat and Hydrology. In 1910, impassable Sunbeam Dam was constructed 20 miles downstream of Redfish Lake. Although several fish ladders and a diversion tunnel were installed during subsequent decades, it is unclear whether enough fish passed above the dam to sustain the run. The dam was partly removed in 1934, after which Redfish Lake runs partially rebounded. Evidence is mixed as to whether the restored runs constitute anadromous forms that managed to persist during the dam years, nonanadromous forms that became migratory, or fish that strayed in from outside the ESU.

Population Trends and Risks. NOAA Fisheries proposed an interim recovery level of 2,000 adult SR sockeye salmon in Redfish Lake and two other lakes in the Snake River Basin (Table 1.3-1 in NMFS (1995)). Low numbers of adult SR sockeye salmon preclude a Cumulative Risk Initiative (CRI)- or Quantitative Analysis of Risks (QAR)-type analysis of the status of this ESU (for more information, see http://www.nwfsc.noaa.gov/cri/index.html). However, because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley Basin between 1990 and 2000, NOAA Fisheries considers the status of this ESU to be dire under any criteria. The risk of extinction is very high.

Snake River Fall Chinook

Life History. Fall chinook salmon in this ESU are ocean-type. Adults return to the Snake River at ages 2 through 5, with age 4 most common at spawning (Chapman *et al.* 1991). Spawning, which takes place in late fall, occurs in the mainstem and in the lower parts of major tributaries (NWPPC 1989; Bugert *et al.* 1990). Juvenile fall chinook salmon move seaward slowly as subyearlings, typically within several weeks of emergence (Chapman *et al.* 1991). Based on modeling by the Chinook Technical Committee, the Pacific Salmon Commission estimates that a significant proportion of SRF chinook (about 36%) are taken in Alaska and Canada, indicating a far-ranging ocean distribution. In recent years, only 19% were caught off Washington, Oregon, and California, with the balance (45%) taken in the Columbia River. Some SRF chinook historically migrated over 1,500 km from the ocean. Although the Snake River population is now restricted to habitat in the lower river, genes associated with the lengthier migration may still reside in the population. Because longer freshwater migrations in chinook salmon tend to be associated with more-extensive oceanic migrations (Healey 1983), maintaining populations occupying habitat that is well inland may be important in continuing diversity in the marine ecosystem as well.

Habitat and Hydrology. With hydrosystem development, the most productive areas of the Snake River Basin are now inaccessible or inundated. The upper reaches of the mainstem Snake River were the primary areas used by fall chinook salmon, with only limited spawning activity reported downstream from Oxbow Dam. The construction of Brownlee Dam (1958), Oxbow Dam (1961), and Hells Canyon Dam (1967) eliminated the primary production areas of SRF chinook salmon. There are now 12 dams on the mainstem Snake River, and they have substantially reduced the distribution and abundance of fall chinook salmon (Irving and Bjornn 1981).

Hatchery Influence. The Snake River system has contained hatchery-reared fall chinook salmon since 1981 (Busack 1991). The hatchery contribution to Snake River Basin escapement has been estimated at greater than 47% (Myers *et al.* 1998). Artificial propagation is recent, so cumulative genetic changes associated with it may be limited. Wild fish are incorporated into the brood stock each year, which should reduce divergence from the wild population. Release of subyearling fish may also help minimize the differences in mortality patterns between hatchery and wild populations that can lead to genetic change (Waples 1999; see NMFS (1999) for further discussion of the SRF chinook salmon supplementation program).

Population Trends and Risks. For the SRF chinook salmon ESU as a whole, NOAA Fisheries estimates that the median population growth rate (lambda) over the base period[3] ranges from 0.94 to 0.86, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (McClure *et al.* 2000). NOAA Fisheries has also estimated the risk of absolute extinction for the aggregate SRF chinook salmon population, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (*i.e.*, hatchery effectiveness equals zero), the risk of absolute extinction within 100 years is 0.40 (McClure *et al*. 2000). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectivenessequals 100%), the risk of absolute extinction within 100 years is 1.00 (McClure *et al*. 2000).

Snake River Spring/Summer Chinook

Life History. In the Snake River, spring and summer chinook share key life history traits. Both are stream-type fish, with juveniles that migrate swiftly to sea as yearling smolts. Depending primarily on location within the basin (and not on run type), adults tend to return after either 2 or 3 years in the ocean. Both spawn and rear in small, high-elevation streams (Chapman *et al.* 1991), although where the two forms coexist, spring-run chinook spawn earlier and at higher elevations than summer-run chinook.

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[3]Estimates of median population growth rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period that varies between spawning aggregations. Population trends are projected under the assumption that all conditions will stay the same into the future.

Habitat and Hydrology. Even before mainstem dams were built, habitat was lost or severely damaged in small tributaries by construction and operation of irrigation dams and diversions, inundation of spawning areas by impoundments, and siltation and pollution from sewage, farming, logging, and mining (Fulton 1968). Recently, the construction of hydroelectric and water storage dams without adequate provision for adult and juvenile passage in the upper Snake River has kept fish from all spawning areas upstream of Hells Canyon Dam.

Hatchery Influence. There is a long history of human efforts to enhance production of chinook salmon in the Snake River Basin through supplementation and stock transfers. The evidence is mixed as to whether these efforts have altered the genetic makeup of indigenous populations. Straying rates appear to be very low.

Population Trends and Risks. For the SRSS chinook salmon ESU as a whole, NOAA Fisheries estimates that the median population growth rate (lambda) over the base period ranges from 0.96 to 0.80, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to the effectiveness of fish of wild origin (McClure *et al*. 2000). NOAA Fisheries has also estimated median population growth rates and the risk of absolute extinction for the seven spring/summer chinook salmon index stocks, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (*i.e.*, hatchery effectiveness equals zero), the risk of absolute extinction within 100 years for the wild component ranges from zero for Johnson Creek to 0.78 for the Imnaha River (McClure *et al*. 2000). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness equals 100 %), the risk of absolute extinction within 100 years ranges from zero for Johnson Creek to 1.00 for the wild component in the Imnaha River (McClure *et al*. 2000).

Snake River Basin Steelhead

Life History. Fish in this ESU are summer steelhead. They enter freshwater from June to October and spawn during the following March to May. Two groups are identified, based on migration timing, ocean-age, and adult size. A-run steelhead, thought to be predominately age-1-ocean, enter freshwater during June through August. B-run steelhead, thought to be age-2-ocean, enter freshwater during August through October. B-run steelhead typically are 75 to 100 mm longer at the same age. Both groups usually smolt as 2- or 3-year-olds. All steelhead are iteroparous, capable of spawning more than once before death.

Habitat and Hydrology. Hydrosystem projects create substantial habitat blockages in this ESU; the major ones are the Hells Canyon Dam complex (mainstem Snake River) and Dworshak Dam (North Fork Clearwater River). Minor blockages are common throughout the region. Steelhead spawning areas have been degraded by overgrazing, as well as by historical gold dredging and sedimentation due to poor land management. Habitat in the Snake River Basin is warmer and drier and often more eroded than elsewhere in the Columbia River Basin or in coastal areas.

Hatchery Influence. Hatchery fish are widespread and stray to spawn naturally throughout the region. In the 1990s, an average of 86% of adult steelhead passing Lower Granite Dam were of hatchery origin. Hatchery contribution to naturally spawning populations varies, however, across the region. Hatchery fish dominate some stocks, but do not contribute to others.

Population Trends and Risks. For the SRB steelhead ESU as a whole, NOAA Fisheries estimates that the median population growth rate (lambda) over the base period ranges from 0.91 to 0.70, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (McClure *et al*. 2000). NOAA Fisheries has also estimated the risk of absolute extinction for the A- and B-runs, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (*i.e.*, hatchery effectiveness equals zero), the risk of absolute extinction within 100 years is 0.01 for A-run steelhead and 0.93 for B-run fish (McClure *et al*. 2000). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness equals 100%), the risk of absolute extinction within 100 years is 1.00 for both runs (McClure *et al*. 2000).

2.1.2.2.2 Factors Affecting the Species within the Action Area

Section 4(a)(1) of the ESA and NOAA Fisheries listing regulations (50 CFR 424) set forth procedures for listing species. The Secretary of Commerce must determine, through the regulatory process, if a species is endangered or threatened based upon any one or a combination of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence.

The proposed action includes activities that will have some level of effects with short-term impacts from category (1) in the above paragraph, and the potential for long-term impacts as described in categories (3) and (5). The characterization of these effects and a conclusion relating the effects to the continued existence of the listed salmon and steelhead that are the subject of this consultation is provided below, in Section 2.1.3.

The major factors affecting SR sockeye, SRF chinook, SRSS chinook, and SRB steelhead within the action area include hydroelectric facility operations and maintenance, and land use and shoreline development. NOAA Fisheries uses the Matrix of Pathways and Indicators (MPI) to analyze and describe the effects of these factors on listed salmon and steelhead. As described above, the MPI relates the biological requirements of listed species to a suite of habitat variables. In the analysis presented here, each factor is considered in terms of its effect on relevant pathways and associated indicators (*properly functioning, at risk, or not properly functioning*).

Hydroelectric Facilities

Hydropower development in the Snake River has profoundly altered the riverscape of the action area, which is located within the Ice Harbor Dam Pool (Lake Sacajawea). This dam and other similar structures have caused a broad range of habitat degradation, and altered the structure and function of the lower Snake River by converting a riverine environment to a series of reservoirs. Consequently, a host of indicators within numerous pathways of the MPI have been affected. Specifically, hydroelectric facility operations and maintenance have altered natural flow regimes, produced broad diel flow fluctuations, altered temperature profiles, inundated spawning habitat, created passage barriers, diminished sediment transport, eliminated lotic channel characteristics, altered riparian habitat, and expanded suitable habitat for piscivorous species (both native and non-native) that prey on or compete with salmonids.

Flow/Hydrology. Streamflow in the Snake River within the action area was historically driven by natural watershed processes, but is presently more significantly controlled by the operation of mainstem dams (*i.e.*, Ice Harbor and Lower Granite). In an unregulated condition, the Snake River in the action area would exhibit the hydrograph of a snowmelt-dominated system where discharge peaked in the spring concurrent with melting snow, and reached baseflow during the mid- to late-summer. Under these conditions, river ecosystems experienced a range of flows that served to promote floodplain riparian ecosystems, provide habitat for aquatic species assemblages, and protect vital ecosystem linkages and channel structure (Leopold *et al.* 1964; Ward and Stanford 1995a; 1995b; Fisher *et al.* 1998). Accordingly, aquatic biota have, over the eons, evolved life-history strategies that are spatially and temporally synchronized to seasonal runoff patterns (Groot *et al.* 1995; Stanford *et al.* 1996).

Presently, however, reservoir operations within the action area have attenuated and truncated the natural runoff regime, and produced a river system that is substantially out of phase with its unregulated, natural hydrograph. Further, hydropower peaking operations often cause broad daily flow fluctuations below dam facilities. Flow regimes that deviate from the natural condition are well understood to produce a diverse array of negative ecological consequences (Hill *et al.* 1991; Ligon *et al.* 1995; Richter *et al.* 1996; Stanford *et al.* 1996). The hydrograph of the Snake River within the action area is temporally and spatially discordant with its supporting watershed and, accordingly, the aquatic and riparian biota of the system have suffered. In the MPI analysis, streamflow falls under the Flow/Hydrology pathway, and Change in Peak/Base flow indicator. Presently, for the reasons described above, this indicator is *not properly functioning*. In this instance, *not properly functioning* is defined as "pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology, and geography."

Water Quality. Water quality within the action area has been degraded by hydroelectric dams that contribute to high instream temperatures, high concentrations of dissolved atmospheric gases, and high concentrations of nutrients and pollutants bound to fine sediments that settle out in reservoir pools (Spence *et al.* 1996; NMFS 2000). Portions of the action area have been placed on the Washington State 303(d) list (Clean Water Act) for degraded temperature, total dissolved gas, and dissolved oxygen parameters (WDOE 1996; 1998). Based on this information, NOAA Fisheries concludes that relevant water quality indicators (Temperature, Sediment/Turbidity, and Chemical Contamination/Nutrients), and thus the Water Quality pathway of the MPI are *not properly functioning*.

Habitat Access. Hydroelectric dams control river stage and flow within the action area and can inhibit safe passage of listed salmonids by creating conditions where listed salmonids may be killed or injured by mechanical impingement or high dissolved gas levels (NMFS 1996a, Spence *et al.* 1996; NMFS 2000). Additionally, the dams create false attraction to impassable areas, habitat for predators, and otherwise delay the progress of migrants. Therefore, based on the direct presence of hydroelectric dams and the secondary passage problems they cause, NOAA Fisheries concludes that the Habitat Access pathway (Physical Barriers indicator) of the MPI is *not properly functioning* within the action area because "manmade barriers present in the watershed prevent upstream and/or downstream fish passage at a range of flows."

Habitat Elements. Yet another consequence of reservoir impoundment for hydropower development is expressed as general habitat degradation within the action area. Habitat is a collective term that encompasses various physical, biological, and chemical interactions within a river and its watershed that produce the spatial and temporal environs in which riverine species exist. Numerous instream and floodplain elements of habitat (*e.g.*, substrate, LWD, pool frequency and quality, off-channel areas, and refugia) are vital to the production and maintenance of native fish assemblages (Everest *et al.* 1985; Bjornn and Reiser 1991; Karr 1991; Spence *et al.* 1996; NRCC 1996; NMFS 1996a).

When the Snake River was transformed into a series of slow moving reservoirs, much of the historic habitat was inundated and most habitat functions were lost (NMFS 2000). Sediment transport has been restricted to the extent that fine materials (silt and sand) settle out of the water column in the reservoirs instead of being flushed downstream (causing sedimentation) (NMFS 1996a). In addition, low water velocity, the physical presence of the dams (both upstream and in the action area), and a management approach that maintains comparatively static reservoir pools act to trap spawning substrates, preventing downstream recruitment (NMFS 1996a). Off-channel habitat, refugia (*i.e.,* remnant habitat that buffers populations against extinction (Sedell *et al.* 1990)), and LWD production areas have been reduced or entirely eliminated by reservoir inundation. Streamflow in the action area is highly regulated between dams, and channel-forming materials and processes are greatly diminished. This wholesale simplification of habitat has reduced or eliminated pools, riffles, and other instream habitat features that are vital to the foodweb and listed salmonids (Stanford *et al.* 1996). These factors have impaired every indicator (*e.g.*, Substrate, LWD, Pool Frequency and Quality, Off-channel Habitat, and Refugia) of the Habitat Elements pathway such that all are *not properly functioning* within the action area.

Channel Condition and Dynamics. Large reservoirs are often the defining hydrologic feature in arid environments such as the action area, and their operational regimes often alter mainstem rivers both upstream and downstream of dam structures, as well as streams tributary to a reservoir pool (Collier *et al.* 1996). Reservoir structural elements and management scenarios force tributaries to equilibrate to new base levels by aggradation or incision, and these mechanisms often cascade throughout each tributary subwatershed (Lane 1955; Williams and Wolman 1984; Montgomery and Buffington 1998; Shields *et al.* 1995, 2000). Gravels trapped behind a dam are no longer available to downstream reaches for bank and bed formation/maintenance, and can limit substratum for spawning salmonids and other members of the riverine food web (Moreau 1984; Ramey *et al.* 1987; Ligon *et al.* 1995; Ward and Stanford 1995b). The availability and cycling of sediment along the river continuum has a controlling influence on channel morphology, floodplain and channel complexity, and riparian species assemblages (Leopold *et al.* 1964; Williams and Wolman 1984; Dunne and Leopold 1978; Vannote *et al.* 1980; Gregory *et al.* 1991; Ligon *et al.* 1995). In addition, altered flow regimes (from an unregulated condition) can impact hydraulic parameters with associated biologic components (*i.e.*, sediment transport, gravel recruitment, and bank stability and morphology) that are important to riverine aquatic species (O'Brien 1984, Williams and Wolman 1984; Waters 1995; Ligon *et al.* 1995). Finally, periodic flooding redeposits silts, provides passage for biota to and from floodplain habitats, leads to extensive nutrient transformations, promotes channel maintenance, facilitates floodplain storage and enhances floodplain biodiversity and production (Bayley 1991; Junk *et al.* 1989; Sedell *et al.* 1989; Power *et al.* 1995).

The Snake River throughout the action area presently bears little resemblance to the riverine environment that existed previous to hydrosystem development. The floodplain and mainstem channel of the Snake River is buried under many feet of reservoir water, and tributary junctions are affected by inundation and pool fluctuation as well. Thus, riverine processes and their ecological linkages important to listed salmonids and the aquatic environment such as those described in the preceding paragraph are greatly diminished if not totally absent. Consequently, all requisite indicators of the Channel Condition and Dynamics pathway (*e.g.*, Width/Depth Ratio, Streambank Condition, and Floodplain Connectivity) are *not properly functioning* in the action area; the historic channel of the Snake River no longer exists save for short tailwater reaches below the dams.

Land Use and Shoreline Development

In the action area of this project, numerous anthropogenic features and/or activities (*e.g.,* dams, marinas, docks, roads, railroads, rip-rap, and landscaping) have become permanent fixtures on the landscape and have displaced and altered native riparian habitat to some degree. Consequently, the potential for normal riparian processes (*e.g*., shading, bank stabilization and LWD recruitment) to occur is diminished, and aquatic habitat has become simplified (Ralph *et al.* 1994; Young *et al.* 1994; Fausch *et al.* 1994; Dykaar and Wigington 2000).

Shoreline development has reduced the quality of nearshore salmonid habitat by eliminating native riparian vegetation, displacing shallow water habitat with fill materials, and by further disconnecting the Snake River from historic floodplain areas. Further, riparian species that evolved under the environmental gradients of riverine ecosystems are not well suited to the present hydraulic setting of the action area (*i.e.*, static, slackwater pools), and are thus often replaced by nonnative, non-native species (Rood and Mahoney 1990; Scott *et al.* 1996; Rood and

Mahoney 2000; Braatne and Jamieson 2001). Therefore, the Watershed Conditions pathway and Riparian Reserves indicator *is not properly functioning* in the action area because "the riparian reserve system is fragmented, poorly connected, and provides inadequate protection of habitats and refugia for sensitive aquatic species (less than 70% intact)."

2.1.3 Effects of the Proposed Action

The proposed permitting of the construction of the Ice Harbor Marina is likely to adversely affect SR sockeye, SRF chinook, SRSS chinook, and SRB steelhead. The portion of the Snake River that flows through the action area is a migration corridor for both adults and smolts, it might also provide juvenile rearing and adult holding habitat for SR sockeye, SRF chinook, SRSS chinook, and SRB steelhead.

NOAA Fisheries' ESA implementing regulations define "effects of the action" as "the direct and indirect effects of an action on the species or Critical Habitat (excluding SRB steelhead) together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline." (50 CFR 402.02).

2.1.3.1 Direct Effects

Direct effects are the immediate effects of the project on the species or its habitat. Direct effects result from the agency action and include the effects of interrelated and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not evaluated (USFWS and NMFS 1998).

<u>2.1.3.1.1 Turbidity</u>

The proposed action includes permitting construction in and near the water. Such construction can mobilize sediments and temporarily increase local turbidity levels in the Snake River. In the immediate vicinity of the construction activities (several meters), the level of turbidity would likely exceed natural background levels and affect fish. The proposed action includes measures to decrease the likelihood and extent of any such affect on listed salmonids. These measures include timing restrictions and construction Best Management Practices (BMPs).

Quantifying turbidity levels, and their effect on fish species is complicated by several factors. First, turbidity from an activity will typically decrease as distance from the activity increases. How quickly turbidity levels attenuate is dependent upon the quantity of materials in suspension (*e.g.*, mass or volume), the particle size of suspended sediments, the amount and velocity of ambient water (dilution factor), and the physical/chemical properties of the sediments. Second, the impact of turbidity on fish is not only related to the turbidity levels, but also the particle size of the suspended sediments.

For salmonids, turbidity has been linked to a number of behavioral and physiological responses (*i.e.*, gill flaring, coughing, avoidance, increase in blood sugar levels) which indicate some level of stress (Bisson and Bilby 1982; Sigler *et al.* 1984; Berg and Northcote 1985; Servizi and Martens 1992). The magnitude of these stress responses are generally higher when turbidity is increased and particle size decreased (Bisson and Bilby 1982; Servizi and Martens 1987; Gregory and Northcote 1993). Although turbidity may cause stress, Gregory and Northcote (1993) have shown that moderate levels of turbidity (35-150 nephelometric turbidity units [NTUs]) accelerate foraging rates among juvenile chinook salmon, likely because of reduced vulnerability to predators (camouflaging effect).

It is expected that turbidity arising from the project will be short-lived and have a low potential for causing take. The project includes measures to reduce or avoid turbidity impacts. These include installation when listed species are least likely to be present near the project site, minimizing the potential for adverse effects. Those fish that are present in the action area when the effects are manifest are likely to be able to avoid the area until the effects dissipate.

2.1.3.2 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. Indirect effects might include other Federal actions that have not undergone section 7 consultation but will result from the action under consideration. These actions must be reasonably certain to occur, or be a logical extension of the proposed action.

<u>2.1.3.2.1 Predation</u>

The Ice Harbor Marina project will add approximately 2,546 square feet of over-water structure of which only 690 square feet will not be grated. Addition of in-water structures and decking can create beneficial structure for fish species that prey on juvenile salmonids. Therefore, predation on listed salmonids could increase as a result of the Ice Harbor Marina project. However, the project includes measures (including grating and reflective dock components) to decrease the likelihood and extent of any such affects on listed salmonids.

Native (*e.g.*, northern pikeminnow (*Ptychocheilus oregonensis*)) and non-native (*e.g.*, smallmouth bass (*Micropterus dolomieu*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis. annularis*), and yellow perch (*Perca flavescens*)), all piscivorous predators, are year-round residents of the Snake River reservoirs and are also known to consume salmonids. While NOAA Fisheries is not aware of any studies which have been done to specifically determine impacts of in/overwater structures in the Snake River system on listed salmonids, numerous analogous predation studies suggest that serious predation impacts from these emplacements could occur. Increased predation impacts are a function of increased predation rates on listed salmonids, as well as increased predator populations from introduced artificial habitat that imparts rearing and ambush habitat for native and non-native predator species.

Four major predatory strategies are utilized by piscivorous fish: prey pursuit, prey ambush, prey habituation to a non-aggressive illusion, or prey stalking (Hobson 1979). Ambush predation is probably the most commonly employed predation strategy. Predators lie-in-wait, then dart out at prey in an explosive rush (Gerking 1994). Oftentimes, predators use sheltered areas that provide velocity shadows to ambush prey fish in faster currents (Bell 1991).

In addition, light plays an important role in both predation success and prey defense mechanisms. Prey species are better able to see predators under high light intensity, thus providing the prey species with a relative advantage (Hobson 1979). Petersen and Gadomski (1994) found that predator success was higher at lower light intensities. Prey fish lose their ability to school at low light intensities, making them vulnerable to predation (Petersen and Gadomski 1994). Howick and O'Brien (1983) found that under high light intensities, prey species (bluegill (*Lepomis macrochirus*)) can locate largemouth bass (*Micropterus salmoides*) before they are seen by the bass. However, under low light intensities, bass can locate the prey before they are seen. Walters *et al.* (1991) indicate that high light intensities may result in increased use of shade-producing structures by predators, while Bell (1991) states that "light and shadow paths are utilized by predators advantageously."

In-water and over-water structures create light/dark interface conditions (*i.e.,* shadows) that allow ambush predators to remain in darkened areas (barely visible to prey) and watch for prey to swim by against a bright background (high visibility). Prey species moving around structure(s) are unable to see predators in dark areas under or beside structure(s) and are more susceptible to predation. Juvenile salmonids, especially ocean type chinook (among others), may utilize backwater areas during their outmigration (Parente and Smith 1981). The presence of predators may force smaller prey fish species into less desirable habitats, disrupting foraging behavior, and depressing growth (Dunsmoor *et al.* 1991). Bevelhimer (1996), in studies on smallmouth bass, indicates that ambush cover and low light intensities create a predation advantage for predators and can also increase foraging efficiency. Ward (1992) found that stomachs of pikeminnow in developed areas of Portland Harbor contained 30% more salmonids than those in undeveloped areas, although undeveloped areas contained more pikeminnows. To minimize the light/dark interface on salmonids the applicant will utilize conservative dock design criteria. Surfacing 100% of the float and ramp will reduce the overall light/dark interfaces that would be produced by using opaque materials. In addition, the floats will be white allowing some reflection of light, further reducing the light/dark interface. However, using conservative dock design criteria does not eliminate the light/dark interrfaces, it only reduces the area impacted or shaded by dock structures in an attempt to reproduce more natural light conditions.

Literature and anecdotal evidence substantiates the use of docks and other structures by juvenile predators for rearing purposes. Juvenile predators may derive a survival advantage from the use of these structures by avoiding predation by their larger conspecifics (Hoff 1991; Carrasquero 2001). In addition, smallmouth bass have been observed to preferentially locate nest sites near artificial structures (Pflug and Pauley 1984; Hoff 1991). Hoff (1991) documents increases of successful smallmouth bass nests of 183% to 443% and increases in catch/effort for fingerlings of 60% to 3,840% in Wisconsin lakes after the installation of half-log structures, concluding that increasing nesting cover in lakes with low nest densities, poor quality and/or quantity of nesting cover, and low first-year recruitment rates can significantly increase recruitment. The Ice Harbor Marina will add 2,546 square feet of overwater structure. These structures may benefit predators by providing cover for predators. By increasing the number of predators, there is the potential to increase the predation pressure on listed salmonids in the action area. To minimize the effects to listed salmonids, the applicant will use conservative dock design criteria (grating and reflective materials). However, the proposed action is still likely to increase rearing habitat for predators, which may improve juvenile survival and lead to an overall predator population increase in the action area.

Native predators such as northern pikeminnow, and introduced predators such as smallmouth bass, black crappie, white crappie, and potentially, yellow perch (Ward *et al.* 1994; Poe *et al.* 1991; Beamesderfer and Rieman 1991; Rieman and Beamesderfer 1991; Petersen *et al.* 1990; Pflug and Pauley 1984; Collis *et al.* 1995) likely utilize habitat created by in/overwater structures (Ward and Nigro 1992; Pflug and Pauley 1984). The proposed action will add both ambush and shadow areas for piscine predators. The SR sockeye, The SRF chinook, SRSS chinook, and SRB steelhead use the action area for migratory purposes, and some individuals may actually rear throughout the area. The extent of increase in predation on salmonids in the Snake River resulting from overwater structures is not well known. Further, salmon stocks with already low abundance are susceptible to further depression by predation (Larkin 1979).

Based on the presence of salmonids and native and non-native predators in the action area, and the additional shading created by the installation of new docks, it appears likely that the proposed action will contribute to increased predation rates on listed juvenile salmonids. Using the best available science, it is impractical at this time to quantify the number of listed salmonids that will be lost to predation as a consequence of the proposed action. However, when added to the environmental baseline, advantageous predator habitat created by this proposed action will likely result in only a minor increase in predation rates on listed salmonids.

<u>2.1.3.2.2 Littoral Productivity</u>

Docks may have some general effects on littoral productivity. The shade that docks create can inhibit the growth of aquatic macrophytes and other plant life (*e.g.*, epibenthic algae and pelagic phytoplankton). The Ice Harbor Marina project will add approximately 2,546 square feet of over-water structure. However, the project includes measures (*i.e*., grating and reflective dock components) to decrease the likelihood and extent of any such affects on listed salmonids.

Aquatic plant life is the foundation for most aquatic food webs and their presence or absence affects many higher trophic levels (*e.g.*, invertebrates and fishes). Autochthonous pathways are of overriding importance in the trophic support of juvenile salmonids (Murphy 1991). In large rivers, autotrophs are more abundant nearer the shore (Naiman *et al.* 1980). Consequently, the shade from docks can affect local plant/animal community structure or species diversity. At a minimum, shade from docks can affect the overall productivity of littoral environments (Kahler *et al.* 2000).

The proposed action includes measures to reduce the likelihood and extent of effects from this activity by incorporating conservative dock design criteria. Surfacing 100% of each float deck with grating and using reflective materials for in-water components is expected to result in more natural light conditions beneath the proposed structures than would result from using traditional materials. In addition, the applicant is proposing to plant a 950-foot section of riparian vegetation to partially compensate for lost productivity. Furthermore, given the small footprint of the docks relative to the total surface area of littoral habitat in the action area, it is unlikely that primary productivity will be affected to an extent that affects fish.

2.1.3.2.3 Boating Activity

Adding new docks may increase levels of boating activity in the reservoirs, especially near the dock. Although the type and extent of boating activity that might be enhanced by the proposed action are outside of the discretionary action under consultation herein, boating activity might cause several impacts on listed salmonids and aquatic habitat. Engine noise, prop movement, and the physical presence of boat hulls may disturb or displace nearby fishes (Mueller 1980; Warrington 1999).

Boat traffic could also cause (1) increased turbidity in shallow waters, (2) uprooting of aquatic macrophytes in shallow waters, (3) aquatic pollution (through exhaust, fuel spills, or release of petroleum lubricants), and (4) shoreline erosion. These boating impacts indirectly affect listed fish in a number of ways. Turbidity may injure or stress affected fishes, as discussed in more detail in Section 2.1.3.1.1. The loss of aquatic macrophytes may expose salmonids to predation, decrease littoral productivity, or alter local species assemblages and trophic interactions. Despite a general lack of data specifically for salmonids, pollution from boats may cause short-term injury, physiological stress, decreased reproductive success, cancer, or death for fishes in general. Further, pollution may also impact fishes by impacts to potential prey species or aquatic vegetation.

The new docks will cause an increase in capacity at Ice Harbor Marina. However, this should only lead to a slight increase in boat use and therefore a negligible effect on listed salmonids.

2.1.3.3 Population Scale Effects

As detailed in Section 2.1.2.2, NOAA Fisheries has estimated the median population growth rate (lambda) for each species affected by the Ice Harbor Marina project. Under the environmental baseline, life history diversity has been limited by the influence of hatchery fish, by physical barriers that prevent migration to historical spawning and/or rearing areas, and by water temperature barriers that influence the timing of emergence, juvenile growth rates, or the timing of upstream or downstream migration. In addition, hydropower development has profoundly altered the riverine environment and those habitats vital to the survival and recovery of the ESUs that are the subject of this consultation.

The Ice Harbor Marina project is expected to add temporary, construction-related effects to the existing environmental baseline. Further, NOAA Fisheries believes that long-term, minor increases in predation rates and predator populations will occur as well. However, these effects, as detailed above, are not expected to have any significance at the population level. Therefore, NOAA Fisheries believes that the proposed action does not contain measures that are likely to influence population trends of the affected ESU.

2.1.3.4 Critical Habitat Effects

NOAA Fisheries designates Critical Habitat for a listed species based upon physical and biological features that are essential to that species. Essential features of Critical Habitat for SR Sockeye, SRF chinook, and SRSS chinook include substrate, water quality/quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (December 28, 1993, 58 FR 68543). Critical Habitat is not currently designated for the SRB steelhead ESU (see footnote 2).

The direct and indirect effects previously discussed include effects on Critical Habitat, to a limited extent. The avenues in which Critical Habitat may be affected are apparent in the MPI analysis: specifically, in the Water Quality, Habitat Access, Habitat Elements, Channel Condition and Dynamics, Flow/Hydrology, and Watershed Conditions pathways. Within these pathways, and when considering the action under consultation in comparison to the environmental baseline, the functional quality of most indicators will be maintained.

The long-term effects of the project are likely to impact safe passage conditions for listed fish, to some degree. Based on the best available scientific data, NOAA Fisheries believes that installing overwater structures will improve predation and rearing conditions for both native and non-native piscivorous fish, and could contribute to at least a localized increase in predator populations. However, when added to the environmental baseline, it appears that the proposed action is unlikely to appreciably diminish the value of this element of Critical Habitat. When the short- and long-term effects of the proposed action are taken as a whole, it appears unlikely that the Ice Harbor Marina project will adversely modify SR Sockeye, SRF chinook, and SRSS chinook Critical Habitat.

2.1.3.5 Cumulative Effects

Cumulative effects are defined as "those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). Future Federal actions that are unrelated to the proposed actions are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

In the action area for this project, agricultural activities are the main land use. Riparian buffers are not properly functioning, containing little woody vegetation. Although land use practices that would result in take of endangered species is prohibited by section 9 of the ESA, such actions do occur. NOAA Fisheries cannot conclude with certainty that any particular riparian habitat will be modified to such an extent that take will occur. Riparian habitat is essential to salmonids in providing and maintaining various stream characteristics such as; channel stabilization and morphology, leaf litter, and shade. However, given the patterns of riparian development in the action area and rapid human population growth of Walla Walla County (13.9% from 1990-2000, U.S. Census Bureau), it is reasonably certain that some riparian habitat will be impacted in the future by non-Federal activities.

At the project site, most land use activities are not expected to substantially change. Charbonneau Park and the surrounding areas are owned by the COE or are in private ownership. There are no known future activities planned on these lands that would adversely affect listed salmonids.

2.1.4 Conclusion/Opinion

NOAA Fisheries has reviewed the direct, indirect, and cumulative effects of the proposed action on the above listed species and their habitat. NOAA Fisheries evaluated these effects in light of existing conditions in the action area and the measures included in the action to minimize the effects. The proposed action is likely to cause short-term adverse effects on listed salmonids by modifying habitat and construction activities. Additionally, the proposed action is likely to cause long-term adverse effects on listed salmonids by increasing predation. However, the short-term and long-term effects are unlikely to reduce salmonid distribution, reproduction, or numbers in any meaningful way and have been minimized to the fullest extent possible. Consequently, the proposed action is not likely to jeopardize the continued existence of listed SR sockeye, SRF chinook, SRSS chinook, and SRB steelhead.

2.1.5 Reinitiation of Consultation

This concludes formal consultation for the Ice Harbor Marina project. Consultation must be reinitiated if: (1) the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; or (4) a new species is listed (50 CFR 402.16). To reinitiate consultation, the COE should contact the Habitat Conservation Division (Washington Branch Office) of NOAA Fisheries. Upon reinitiation, the protection provided by this incidental take statement, section 7(o)(2), becomes invalid.

2.2 Incidental Take Statement

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species without special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined as significant habitat modification or degradation that results in death or injury to listed species by "significantly impairing behavioral patterns such as breeding, spawning, rearing, migrating, feeding, and sheltering" (50 CFR 222.102). Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the effects of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures (RPMs) that are necessary to minimize take and sets forth terms and conditions with which the action agency must comply to implement the reasonable and prudent measures.

2.2.1 Amount or Extent of Take Anticipated

As stated in Section 2.1.1, above, listed salmon and steelhead use the action area for migratory purposes and possibly rearing. Also, as detailed in NMFS (2000) it is possible to encounter SR sockeye, SRF chinook, SRSS chinook, and/or SRB steelhead in the action area any day of the year. Therefore, incidental take of these listed fish is reasonably certain to occur. The proposed action includes measures to reduce the likelihood and amount of incidental take. To ensure the action agency understands these measures are mandatory, take minimization measures included as part of the proposed action are restated in the Terms and Conditions provided below.

Take caused by the proposed action is likely in the form of harm, where habitat modifications will impair normal behavior patterns of listed salmonids. Harm is likely to result from increased predation because of the construction of new in-water and over-water structures. The amount or extent of take from these causes is difficult, if not impossible to estimate. In instances where the number of individual animals to be taken cannot be reasonably estimated, NOAA Fisheries uses a surrogate approach. The surrogate should provide an obvious threshold of authorized take which, if exceeded, provides a basis for reinitiating consultation.

This Opinion analyzes the extent of effects that will result from adding approximately 2,546 square feet of over-water structure in the action area. Despite the use of the best scientific and commercial data available, NOAA Fisheries cannot estimate the number of fish that will be injured or killed by these occurrences. Therefore, the extent of take anticipated in this statement is that which will occur from the addition of 2,546 square feet of additional over-water structure. Should this threshold be exceeded during project activities, the reinitiation provisions of this Opinion apply.

2.2.2 Reasonable and Prudent Measures

The measures described below are non-discretionary. They must be implemented so that they become binding conditions in order for the exemption in section 7(a)(2) to apply. The COE has the continuing duty to regulate the activities covered in this incidental take statement. If the COE fails to adhere to the terms and conditions of the incidental take statement through enforceable terms added to the document authorizing this action, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

NOAA Fisheries believes that the following reasonable and prudent measures, along with conservation measures described by the COE, are necessary and appropriate to minimize the take of ESA-listed fish resulting from implementation of this Opinion.

1. The COE will minimize the incidental take from boat docks by applying methods to avoid or minimize creating predator habitat.

2. The COE will minimize the incidental take from activities involving use of heavy equipment, vehicles, earthwork, site restoration, or that may otherwise involve in-water work or affect fish passage by applying methods to avoid or minimize disturbance to riparian and aquatic systems.

2.2.3 Terms and Conditions

To comply with ESA section 7 and be exempt from the prohibitions of section 9 of the ESA, the COE must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These Terms and Conditions largely reflect measures described as part of the proposed action in the BA and the foregoing Opinion. NOAA Fisheries has included them here to ensure that the action agency is well aware that they are non-discretionary.

1. To implement Reasonable and Prudent Measure No. 1 (minimize predator habitat), the COE shall ensure that:

    1.1 Grating will be rated at greater than 60% open space.

    1.2 White or light grey dock components will be used below the surface (flotation).

    1.3 All reflective dock components below the water surface (floats) will be cleaned at least annually (prior to March 1) without chemicals, such that the components remain bright and reflective through the spring and summer outmigration of listed salmonids.

1.4 Grated surfaces on the docks will not be used for storage or other purposes that will reduce natural light penetration through the structure.

1.5 The entire surface of the float and ramps will be fully grated.

2. To Implement Reasonable and Prudent Measure No. 2, the COE shall ensure that:

2.1 The Contractor develops and implements a site-specific SPCCP, and is responsible for containment and removal of any toxicants released. The Contractor will be monitored by the COE to ensure compliance with this SPCCP. The plan must contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations.

2.1.1 Practices to prevent erosion and sedimentation associated with access roads, stream crossings, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations and staging areas.

2.1.2 Practices to confine, remove and dispose of excess concrete, cement, and other mortars or bonding agents, including measures for washout facilities.

2.1.3 A description of any hazardous products or materials that will be used for the project, including procedures for inventory, storage, handling, and monitoring.

2.1.4 A spill containment and control plan with notification procedures, specific clean up and disposal instructions for different products, quick response containment and clean up measures that will be available on the site, proposed methods for disposal of spilled materials, and employee training for spill containment.

2.2 All discharge water created by construction (*e.g.*, concrete washout, pumping for work area isolation, vehicle wash water) will be treated as follows:

2.2.1 Facilities must be designed, built, and maintained to collect and treat all construction discharge water using the best available technology applicable to site conditions. The treatment must remove debris, nutrients, sediment, petroleum hydrocarbons, metals, and other pollutants likely to be present.

2.3 Material removed during excavation will only be placed in locations where it cannot enter streams, wetlands, or other water bodies.

2.4 The following erosion and pollution control materials shall be onsite:

2.4.1 A supply of erosion control materials (*e.g.*, silt fence and straw bales) is on hand to respond to sediment emergencies. Sterile straw or hay bales will be used when available to prevent introduction of non-native plants.

2.4.2 An oil absorbing, floating boom is available on-site during all phases of construction. The boom must be of sufficient length to span the wetted channel.

2.4.3 All temporary erosion controls (*e.g.*, straw bales, silt fences) are in-place and appropriately installed downslope of project activities within the riparian area. Effective erosion control measures will be in-place at all times during the contract, and will remain and be maintained until such time that permanent erosion control measures are effective.

2.5 All exposed or disturbed areas will be stabilized to prevent erosion.

2.5.1 Areas of bare soil within 150 feet of waterways, wetlands, or other sensitive areas will be stabilized by native seeding, mulching, and placement of erosion control blankets and mats, if applicable, but within 14 days of exposure.

2.5.2 All other areas will be stabilized as quickly as reasonable, but within 14 days of exposure.

2.5.3 Seeding outside of the growing season will not be considered adequate nor permanent stabilization.

2.6 Any hazardous materials spill will be reported to NOAA Fisheries.

2.6.1 In the event of a hazardous materials or petrochemical spill, immediate action shall be taken to recovery toxic materials from further impacting aquatic or riparian resources.

2.6.2 In the event of a hazardous materials or petrochemical spill, a detailed description of the quantity, type, source, reason for the spill, and actions taken to recover materials will be documented. The documentation should include photographs.

2.7 Vehicle and stationary power equipment refueling, staging, and hazardous materials.

2.7.1 Vehicle staging, cleaning, maintenance, and fuel storage must take place in a vehicle staging area placed 150 feet or more from any stream, water body, or wetland.

2.7.2 All vehicles operated within 150 feet of any stream, water body, or wetland must be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected must be repaired in the vehicle staging area before the vehicle resumes operations.

2.7.3 All equipment operated instream must be cleaned before beginning operation below the OHWL to remove all external oil, grease, dirt, and mud.

2.7.4 Stationary power equipment (*e.g.*, generators, cranes) operated within 150 feet of any stream, water body, or wetland must be diapered to prevents leaks, unless otherwise approved in writing by NOAA Fisheries.

2.7.5 No auxiliary fuel tanks will be stored within 150 feet of the OHWL.

2.8 All project operations, except efforts to minimize storm or high flow erosion, will cease under high flow conditions that may result in inundation of the immediate work area.

2.9 All work occur between June 15 and August 31.

3.0 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));

- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A));

- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

3.2 Identification of EFH

Pursuant to the MSA the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: chinook; coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

3.3 Proposed Actions

The proposed action and action area are detailed above in Section 1.2 and 1.3 of this document. The action area includes habitats that have been designated as EFH for various life-history stages of chinook and coho salmon.

3.4 Effects of Proposed Action

As described in detail in Section 2.1.3 of this document, the proposed action may result in short- and adverse effects to a variety of habitat parameters.

1. The proposed action will result in a temporary risk of contamination of waters through the accidental spill or leakage of petroleum products from heavy equipment.

2. The proposed action will result in a short-term degradation of water quality (turbidity) because of construction activities.

3.5 Conclusion

NOAA Fisheries concludes that the proposed action will adversely affect designated EFH for chinook and coho salmon.

3.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. While NOAA Fisheries understands that the conservation measures described in the BA will be implemented by the COE, it does not believe that these measures are sufficient to address the adverse impacts to EFH described above. To minimize the adverse effects to designated EFH for Pacific salmon (contamination of waters, suspended sediment, and predation), NOAA Fisheries recommends that the COE implement Term and Condition No. 2 as described in Section 2.2.3 of this document.

3.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR 600.920(l), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

3.8 Supplemental Consultation

The COE must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920(k)).

4.0 REFERENCES

Bayley, P. B. 1991. The flood pulse advantage and the restoration of river-floodplain systems. Regulated Rivers 6: 75-86.

Beamesderfer, R. C., and B. E. Rieman. 1991. Abundance and Distribution of Northern Squawfish, Walleye, and Smallmouth Bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:439-447.

Bell, M. C. 1991. Fisheries handbook of Engineering requirements and biological criteria. Fish Passage Development and Evaluation Program. U.S. Army Corps of Engineers. North Pacific Division.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of. Fisheries and Aquatic Science 42: 1410-1417.

Bevelhimer, M. S. 1996. Relative importance of temperature, food, and physical structure to habitat choice by smallmouth bass in laboratory experiments. Transactions of the American Fisheries Society 125:274-283.

Bishop, S., and A. Morgan, (*eds.*). 1996. Critical habitat issues by basin for natural chinook salmon stocks in the coastal and Puget Sound areas of Washington State. Northwest Indian Fisheries Commission, Olympia, WA. 105 pp.

Bisson, P. A., and R. E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. North American Journal Fisheries Management 4: 371-374.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 *in* W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. Special Publication 19. American Fisheries Society, Bethesda, Maryland.

Braatne, J. H., and B. Jamieson. 2001. The impacts of flow regulation on riparian cottonwood forests of the Yakima River. Prepared for the Bonneville Power Administration, Portland, OR. Report to Bonneville Power Administration, Portland, OR. Contract No. 00000005, Project No. 200006800,(BPA Report DOE/BP-00000005-3). 69 pp.

Bretz, J. H. 1969. The Lake Missoula floods and the channeled scabland. Journal of Geology. 77: 505-543.

Bugert, R., P. LaRiviere, D. Marbach, S. Martin, L. Ross, and D. Geist 1990. 1989 Annual Report of Lower Snake River Compensation Plan, Salmon Hatchery Evaluation Program, to U.S. Fish and Wildlife Service (Cooperative Agreement 14-16-0001-89525).

Busack, C. 1991. Genetic evaluation of the Lyons Ferry Hatchery stock and wild Snake River fall chinook. Washington Department of Fisheries, Report to ESA Administrative Record for Fall Chinook Salmon, Olympia. May.

Busby, P., S. Grabowski, R. Iwamoto, C. Mahnken, G. Matthews, M. Schiewe, T. Wainwright, R. Waples, J. Williams, C. Wingert, and R. Reisenbichler. 1995. Review of the status of steelhead (Oncorhynchus mykiss) from Washington, Idaho, Oregon, and California under the U.S. Endangered Species Act.

Busby, P., T. Wainwright, G. Bryant, L. Lierheimer, R. Waples, F. Waknitz, and I. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Department of Commerce. NOAA Tech. Memo. NMFS-NWFSC-27, 261 pp.

Campton, D. E., and J. M. Johnston. 1985. Electrophoretic evidence for a genetic admixture of native and nonnative rainbow trout in the Yakima River, Washington. Transactions of the American Fisheries Society 114: 782-793.

Carrasquero, J. 2001. Over-water structures: freshwater issues. White paper, 12 April, 2001. Submitted to Washington State Department of Fish and Wildlife, Washington State Department of Ecology and Washington State Department of Transportation.

Chapman, D., A. Giorgi, M. Hill, A. Maule, S. McCutcheon, D. Park, W. Platts, K. Prat, J. Seeb, L. Seeb, and others. 1991. Status of Snake River chinook salmon. Don Chapman Consultants, Inc., Boise, Idaho, for Pacific Northwest Utilities Conference Committee.

Collier, M., R. H. Webb, and J. C. Schmidt. 1996. A primer on the downstream effects of dams. U.S. Geological Survey Circular 1126. 94 pp.

Collis, K., R. E. Beaty, and B. R. Crain. 1995. Changes in Catch Rate and Diet of Northern Squawfish Associated With the Release of Hatchery-Reared Juvenile Salmonids in a Columbia River Reservoir. North American Journal of Fisheries Management 15: 346-357.

Columbia Basin Fish and Wildlife Authority (CBFWA). 1990. Snake River subbasin (mainstem from mouth to Hells Canyon Dam) salmon and steelhead production plan. CBFWA, Northwest Power Planning Council, Portland, Oregon.

Dunne, T., and Leopold, L. B. 1978. Water in Environmental Planning: Freeman, San Francisco, 818 pp.

Dunsmoor, L. K., D. H. Bennett, and J. A. Chandler. 1991. Prey selectivity and growth of a planktivorous population of smallmouth bass in an Idaho reservoir. Pages 14-23 *in* D.C.

Jackson (ed) The First International Smallmouth Bass Symposium. Southern Division American Fisheries Society. Bethesda, Maryland.

Dykaar, B. D., and P. J. Wigington, Jr. 2000. Floodplain formation and cottonwood colonization patterns on the Willamette River, Oregon, U.S.A. Environmental Management 25: 87-104.

Everest, F. H., N. B. Armantrout, S. M. Keller, W. D. Parante, J. R. Sedell, T. E. Nickelson, J. M. Johnston, and G. N. Haugen. 1985. Salmonids. pp. 199-230 *in* E. R. Brown, editor. Management of wildlife and fish habitats in forests of western Oregon and Washington.

Evermann, B. W. 1895. A preliminary report upon salmon investigations in Idaho in 1894. U.S. Fish Commission Bulletin 15:253-284.

Faler, M. P., L. M. Miller, and K. I. Welke. 1988. Effects of variation in flow on distributions of northern squawfish in the Columbia River below McNary Dam. N. Am. J. Fish. Manage. 8: 30-35.

Fausch, K. D., C. Gowan, A. D. Richmond, and S. C. Riley. 1994. The role of dispersal in trout population response to habitat formed by large woody debris in Colorado mountain streams. Bulletin Français de la Pêche et de la Pisciculture 337/338/339:179-190.

Fisher, S. G., N. B. Grimm, E. Marti, R. M. Holmes and J. B. Jones, Jr. 1998. Material spiraling in stream corridors: a telescoping ecosystem model. Ecosystems 1(1): 19-34.

Fulton, L. A. 1968. Spawning areas and abundance of chinook salmon, *Oncorhynchus tshawytscha*, in the Columbia River basin – past and present. U.S. Fish and Wildlife Service, Special Scientific Report, Fisheries 571:26.

Gerking, S. D. 1994. Feeding Ecology of Fish. Academic Press Inc., San Diego, CA. 416 pp.

Gregory, S. V., F. J. Swanson, W. A. McKee, and K. W. Cummins. 1991. An ecosystem perspective of riparian zones. Bioscience 41: 540-551.

Gregory, R. S., and T. S. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile chinook salmon (*Oncorhynchus tshawytscha*) in turbid laboratory conditions. Canadian Journal of Fisheries and Aquatic Sciences 50: 223-240.

Groot C., L. Margolis, and W. C. Clarke (*eds*.). 1995. Physiological Ecology of Pacific Salmon. Univ. British Columbia Press, Vancouver.

Gustafson, R. G., T. C. Wainwright, G. A. Winans, F. W. Waknitz, L. T. Parker, and R. S. Waples. 1997. Status review of sockeye salmon from Washington and Oregon. National

Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memorandum NMFS-NWFSC-33, Seattle, Washington.

Healey, M. C. 1983. Coastwide distribution and ocean migration patterns of stream- and ocean-type chinook salmon, *Oncorhynchus tshawytscha*. Canadian Field-Naturalist 97:427-433.

Hilborn, R. 1992. Can fisheries agencies learn from experience? Fisheries 17: 6-14.

Hill, M. T., W. S. Platts, and R. L. Bescha. 1991. Ecological and geomorphological concepts for instream and out-of-channel flow requirements. Rivers 2(3): 198-210.

Hobson, E. S. 1979. Interactions between piscivorous fishes and their prey. Pages 231-242 *in* R. H. Stroud and H. Clepper, editors. Predator-prey systems in fisheries management. Sport Fishing Institute, Washington D.C.

Hoff, M. H. 1991. Effects of increased nesting cover on nesting and reproduction of smallmouth bass in northern Wisconsin lakes. Pages 39-43 in D.D. Jackson, editor, First International Smallmouth Bass Symposium. Southern Division of the American Fisheries Society, Bethesda, Maryland, U.S.A.

Howick, G. L., and W. J. O'Brien. 1983. Piscivorous feeding behavior of largemouth bass: an experimental analysis. Transactions of the American Fisheries Society 112:508-516 . Unit, University of Idaho, Moscow, for U.S. Fish and Wildlife Service.

Hynes, H. B. N. 1983. Groundwater and stream ecology. Hydrobiologia 100: 93-99.

Irving, J. S., and T. C. Bjornn. 1981. Status of Snake River fall chinook salmon in relation to the Endangered Species Act. Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow, for U.S. Fish and Wildlife Service.

Junk, W. J., P. B. Bayley and R. E. Sparks. 1989. The flood pulse concept in river-floodplain systems. Pp. 110-127, *in*: D. P. Dodge (ed.), Proceedings of the International Large River Symposium. Canadian Special Publication of Fisheries and Aquatic Sciences 106.

Kahler, T., M. Grassley and D. Beauchamp. 2000. A summary of the effects of bulkheads, piers and other artificial structures and shorezone development on ESA-listed salmonids in lakes. City of Bellevue, Bellevue, Washington. 74pp.

Karr, J. R. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1: 66-84.

Lane, E. W. 1955. The importance of fluvial geomorphology in hydraulic engineering. Proceedings of the American Society of Civil Engineers, 81(1).

Larkin, P. A. 1979. Predator-prey relations in fishes: an overview of the theory. Pages 13-22 *in* R. H. Stroud and H. Clepper, editors. Predator-prey systems in fisheries management. Sport Fishing Institute, Washington D.C.

Leopold, L. B., M. G. Wolman and J. P. Miller. 1964. Fluvial processes in geomorphology. W. H. Freeman and Company, San Francisco, CA.

Ligon, F. K., W. E. Dietrich and W. J. Trush. 1995. Downstream ecological effects of dams. Bioscience 45 (3): 183-192.

Malde, H. E. 1968. The catastrophic late Pleistocene Bonneville flood in the Snake River Plain, Idaho. US Geol. Surv. Prof. Pap. No. 596, 52 pp.

Matthews, G. M., and R. S. Waples. 1991. Status review for Snake River spring and summer chinook salmon. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS F/NWC-200, 75 pp.

McClure, B. S, E. Holmes, C. Jordan, P. Kareiva, and P. Levin. 2000. Revised Appendix B of standardized quantitative analysis of the risks faced by salmonids in the Columbia River basin. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. September.

McMichael, G. A., A. L. Fritts, T. N. Pearsons and J. L. Dunnigan. 1998. Lower Yakima River Predatory Fish Monitoring: Progress Report 1998. Washington Department of Fish and Wildlife and Yakima Indian Nation, 39 p.

Minshall, G. W., R. C. Petersen, K. W. Cummins, T. L. Bott, J. R. Sedell, C. E. Cushing and R.L. Vannote. 1983. Interbiome comparison of stream ecosystem dynamics. Ecological Monographs 51: 1-25.

Minshall, G. W., K. W. Cummins, R. C. Petersen, C. E. Cushing, D. A. Bruns, J. R. Sedell, R. L. Vannote. 1985. Developments in stream ecosystem theory. Can. J. Fish. Aquat. Sci. 42: 1045-1055.

Montgomery, D. R. and J. M. Buffington. 1998. Channel process, classification, and response. *In*: Naiman, R. J. and R.E. Bilby (*eds*.). River Ecology and Management: Lessons from the Pacific Coastal Ecoregion. Springer-Verlag, New York, New York, USA.

Moreau, J. K. 1984. Anadromous salmonid habitat enhancement by boulder placement in Hurdygurdy Creek, California. In: Proc. Pacific Northwest Stream Habitat Management Workshop, Humboldt State University, Arcata, California, 97 pp.

Mueller, G. 1980. Effects of recreational river traffic on nest defense by longear sunfish. Transactions of the American Fisheries Society 109: 248-251.

Murphy, M. L., and W. R. Meehan. 1991. Stream ecosystems. American Fisheries Society Special Publication 19: 17-46.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce., NOAA Tech. Memo. NMFS-NWFSC-35, 443 pp.

Naiman, R. J., and J. R. Medell. 1980. Relationships between metabolic parameters and stream order in Oregon. Canadian Journal of Fisheries and Aquatic Sciences 37: 834-847.

National Marine Fisheries Service (NMFS). 1995. Proposed Recovery Plan for Snake River Salmon. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

National Marine Fisheries Service (NMFS). 1996a. Factors for decline: a supplement to the notice of determination for West Coast steelhead under the Endangered Species Act. National Marine Fisheries Service, Protected Resources Branch, Portland, Oregon.

National Marine Fisheries Service (NMFS). 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. NOAA Technical Memo NMFS-NWFSC-35. 443 pp.

National Marine Fisheries Service (NMFS). 1999. Biological opinion on artificial propagation in the Columbia River basin – incidental take of listed salmon and steelhead from Federal and non-Federal hatchery programs that collect, rear, and release unlisted fish species. NMFS, Endangered Species Act Section 7 consultation. March 29.

National Marine Fisheries Service (NMFS). 2000. Biological Opinion on Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin. Northwest Region, Portland, OR.

National Research Council Committee on Protection and Management of Pacific Northwest Anadromous Salmonids (NRCC). 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academy Press, Washington, DC, 452 pp.

NWPPC (Northwest Power Planning Council). 1989. Snake River subbasin salmon and steelhead plan. NWPPC, Portland, Oregon.

Nehlsen, W., J.E. Williams and J.A. Lichatowich. 1991. Pacific salmon at the crossroads: Stocks at risk from California, Oregon, Idaho and Washington. Fisheries 16: 4-21.

O'Brien, J. S. 1984. Hydraulic and sediment transport investigation: Yampa River, Dinosaur National Monument, Report 83-8, Final Report to the National Park Service, Water Resources Field Support Laboratory, Colorado State University, Fort Collins, Colorado.

O'Connor, J. E., 1993. Hydrology, hydraulics and geomorphology of the Bonneville Flood, Geological Society of America Special Paper #274, Geological Society of America, Boulder, Colorado, 83p.

Omernik, J. M. 1987. Ecoregions of the conterminous United States. Annals of the Association of American Geographers 77: 118-125.

Pacific Fishery Management Council (PFMC). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Portland, Oregon.

Parente, W. D. and, J. G. Smith. 1981. Columbia River Backwater Study Phase II. U.S. Dept of Interior. Fisheries Assistance Office. Vancouver, Washington. 87 pp.

Petersen, C. J., D. B. Jepsen, R. D. Nelle, R. S. Shively, R. A. Tabor, and T. P. Poe. 1990. System-Wide Significance of Predation on Juvenile Salmonids in Columbia and Snake River Reservoirs. Annual Report of Research. Bonneville Power Administration Contract DE- AI79-90BP07096. Project No. 90-078. 53 pp.

Petersen, J. M. and D. M. Gadomski. 1994. Light-Mediated Predation by Northern Squawfish on Juvenile Chinook Salmon. Journal of Fish Biology 45 (supplement A), 227-242.

Pflug, D. E. and G. B. Pauley. 1984. Biology of smallmouth bass (*Micropterus dolomieui*) in Lake Sammamish, Washington. Northwest Science 58: 118-130.

Poe, T. P., H. C. Hansel, S. Vigg, D. E. Palmer, and L. A. Prendergast. 1991. Feeding of Predaceous Fishes on Out-Migrating Juvenile Salmonids in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120: 405-420.

Power, M. E., A. Sun, G. Parker, W. E. Dietrich and J. T. Wootton. 1995. Hydraulic food chain models. BioScience 45: 159-167.

Ralph, S. C., G. C. Poole, L. L. Conquest, and R. J. Naiman. 1994. Stream channel morphology and woody debris in logged and unlogged basins of western Washington. Canadian Journal of Fisheries and Aquatic Sciences 51: 37-51.

Ramey, M.P., D. W. Reiser, and S. Beck. 1987. Evaluation of the effects of reduced spill and recommended flushing flows below Rock Creek and Cresta Dams on the North Fork of the Feather River. Completion Report, Pacific Gas and Electric Company, San Ramon, California.

Richter, B. D., J. V. Baumgartner, J. Powell, and D.P. Braun. 1996. A Method for Assessing Hydrologic Alteration Within Ecosystems. Conservation Biology, 10: 1163-1174.

Rieman, B. E., and R. C. Beamesderfer. 1991. Estimated Loss of Juvenile Salmonids to Predation by Northern Squawfish, Walleye, and Smallmouth Bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120: 448-458.

Rood S. B., and J. M. Mahoney. 1990. Collapse of Riparian Poplar Forests Downstream from Dams in Western Prairies: Probable causes and Prospects for Mitigation, Environmental Management, 14: 451-464.

Rood, S. B. and Mahoney, J. M. 2000. Revised instream flow regulation enables cottonwood recruitment along the St. Mary River, Alberta. Rivers 7(2): 109-125.

Scott M. L., J. M. Friedman, G. T. Auble, 1996. Fluvial Process and the Establishment of Bottomland Trees, Geomorphology 14: 327-339.

Sedell, J. R., J. E. Richey and F. J. Swanson. 1989. The river continuum concept: a basis for the expected ecosystem behavior of very large rivers? Canadian Special Publications of Fisheries and Aquatic Sciences 106: 110-127.

Sedell, J. R., G. H. Reeves, F. R. Hauer, J. A. Stanford, and C. P. Hawkins. 1990. Role of refugia in recovery from disturbances: Modern fragmented and disconnected river systems. Environmental Management 14: 711-724.

Servizi, J. A., and D. W. Martens. 1987. Some effects of suspended Fraser River sediments on sockeye salmon (*Oncorhynchus nerka*), pp. 254-264. *In* H. D. Smith, L. Margolis, and C. C. Wood *eds.* Sockeye salmon (*Oncorhynchus nerka*) population biology and future management. Canadian Special Publications of Fisheries and Aquatic Sciences 96.

Servizi, J. A., and D. W. Martens. 1992. Sublethal responses of coho salmon (*Oncorhynchus kisutch*) to suspended sediments. Canadian Journal of Fisheries and Aquatic Sciences 49: 1389-1395.

Shields, F. D., Jr., S. S. Knight, and C. M. Cooper. 1995. Rehabilitation of watersheds with incising channels. Water Resources Research Bulletin. 31(6): 972-982.

Shields, F. D., Jr., A. Simon, and L. J. Steffen. 2000. Reservoir effects on downstream channel migration. Environmental Conservation. 27(1): 54-66.

Sigler, J. W., T. C. Bjornn, and F. H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Transactions of the American Fisheries Society 113: 142-150.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon.

Stanford, J. A. 1994. Instream Flows to Assist the Recovery of Endangered Fishes of the Upper Colorado River Basin. U.S. Department of the Interior, National Biological Survey. Biological Report #24, 47 pp.

Stanford, J. A., and F. R. Hauer. 1992. Mitigating the impacts of stream and lake regulation in the Flathead River catchment, Montana, U.S.A.: an ecosystem perspective. Aquatic Conservation: marine and freshwater ecosystems 2: 35-63.

Stanford, J. A., J. V. Ward, W. J. Liss, C. A. Frissell, R. N. Williams, J. A. Lichatowich and C.C. Coutant. 1996. A general protocol for restoration of regulated rivers. Regulated Rivers 12: 391-413.

Stanford, J. A. and T. Gonser. 1998. Special Issue. Rivers in the Landscape: Riparian and groundwater ecology. Freshwater Biology 40(3): 401-585.

Tabor, R. A., R.S. Shivley, and T. P. Poe. 1993. Predation on juvenile salmonids by smallmouth bass and northern squawfish in the Columbia River near Richland, Washington. N. Am. J. Fish. Manage. 13:

831-838.

U.S. Army Corps of Engineers (COE). 1989. Annual fish passage report, Columbia and Snake river projects. Corps, Portland District, Portland, Oregon, and Walla Walla District, Walla Walla, Washington.

U.S. Census Bureau. 2000. Census of Population. http://quickfacts.census.gov.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. U.S. Government Printing Office. Washington D.C.

Vannote, R. L., G. W. Minshall, K. W. Cummins, J. R. Sedell and C. E. Cushing. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Sciences 37: 130-137.

Wallace, J. B., J. R. Webster and T. F. Cuffney. 1982. Stream detritus dynamics: regulation by invertebrate consumers. Oecologia 53:197-200.

Walters, D. A., W. E. Lynch, Jr., and D. L. Johnson. 1991. How depth and interstice size of artificial structures influence fish attraction. North American Journal of Fisheries Management. 11: 319-329.

Waples, R. S. 1999. Dispelling some myths about hatcheries. Fisheries 24(2):12-21.

Waples, R. S., O. W. Johnson, and R. P. Jones, Jr. 1991a. Status review for Snake River sockeye salmon. National Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memorandum NMFS F/NWC-195, Seattle, Washington.

Waples, R.S., R. P. Jones, Jr., B. R. Beckman, and G. A. Swan. 1991b. Status Review for Snake River Fall Chinook Salmon. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-201. 73 pp.

Ward, D. L. 1992. Effects of waterway development on anadromous and resident fish in Portland Harbor. Final Report of Research. Oregon Dept. of Fish and Wildlife. 48 pp.

Ward, D. L., and A. A. Nigro. 1992. Differences in fish assemblages among habitats found in the lower Willamette River, Oregon: Application of and Problems With Multivariate Analysis. Fisheries Research 13: 119-132.

Ward, D. L., A. A. Nigro, R. A. Farr, and, C. J. Knutsen. 1994. Influence of Waterway Development on Migrational Characteristics of Juvenile Salmonids in the Lower

Willamette River, Oregon. North American Journal of Fisheries Management 14: 362-371.

Ward, J. V., and J. A. Stanford. 1995a. The serial discontinuity concept: extending the model to floodplain rivers. Regulated Rivers 10: 159-168.

Ward, J. V., and J. A. Stanford. 1995b. Ecological connectivity in alluvial river ecosystems and its disruption by flow regulation. Regulated Rivers 11(1): 105-119.

Warrington, P. D. 1999. Impacts of recreational boating on the aquatic environment. http://www.nalms.org/bclss/impactsrecreationboat.htm.

Washington Department of Ecology (WDOE). 1996. Impairment and threatened waterbodies requiring additional pollution controls proposed 1996 Section 303(d) list. Washington State Department of Ecology Water Quality Report ECY# WQ-R-95-83, Olympia, WA. 25 pp.

Washington Department of Ecology (WDOE). 1998. Final 1998 303(d) list of impaired and threatened waterbodies. http://www.ecy.wa.gov.

Washington Department of Fisheries and Washington Department of Wildlife (WDFW). 1993. Washington State Salmon and Steelhead Stock Inventory. Appendix Three; Columbia River Stocks. Washington Department of Fisheries, Olympia, Washington.

Washington State Ferries. 2001. January 2001 Dive Report for Mukilteo Wingwall Replacement Project memorandum. April 30, 2001.

Waters, T. F. 1995. Sediment in streams: Sources, biological effects and controls. American Fisheries Society Monograph 7, Bethesda, Maryland.

Williams, G. P., and M. G. Wolman. 1984. Downstream effects of dams on alluvial rivers. U.S. Geological Survey Professional Paper No. 1286. 83 pp.

Williamson, A. K., M. D. Munn, S. J. Ryker, R. J. Wagner, J. C. Ebbert, and A. M. Vanderpool. 1998. Water quality in the Central Columbia Plateau, Washington and Idaho, 1992-95. USGS Circular 1144. USGS National Water Quality Assessment Program.

Wydoski, R. S. and R. R. Whitney. 1979. Inland Fishes of Washington. Univ. of Washington Press, Seattle, WA. 220 p.

Young, M. K., D. Haire, and M. Bozek. 1994. The effect and extent of railroad tie drives in streams of southeastern Wyoming. Western Journal of Applied Forestry 9(4): 125-130.